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CARNIVOROUS PLANT NEWSLETTER

VOLUME 12, Number 1 MARCH 1983

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CARNIVOROUS PLANT NEWSLETTER

Official Journal of the International Carnivorous Plant Society

Volume 12, Number 1
March 1983

COVER

Harry Abel, 3431 Landrum Dr., Smyrna, GA 30080, sent this photo of an entry in a Japanese bonsai contest. The naturalistic planting includes *S. rubra* 'gulfensis' from Yellow River as the main planting, *S. psittacina* and *S. rubra* × *psittacina*. The ground cover is *D. spathula* and *Utricularia*. The container is a hand-made "pinch pot." The culture is complicated due to the fact that the container is only ½" (1.25 cm) deep.

The co-editors of CPN would like everyone to pay particular attention to the following policies regarding your dues to the ICPS.

All correspondence regarding dues, address changes and missing issues should be sent to Mrs. Pat Hansen, 3321 Hamell Rd., Fullerton, CA 92635. DO NOT SEND TO THE CO-EDITORS. Checks for subscriptions and reprints should be made payable to CSUF FOUNDATION-ICPS.

All material for publication, comments and general correspondence about your plants, field trips or special noteworthy events relating to CP should be directed to one of the co-editors. We are interested in all news related to carnivorous plants and rely on the membership to supply us with this information so that we can share it with others.

Views expressed in this publication are those of the authors, not necessarily the editorial staff.

Copy deadline for the June issue is May 1, 1983.

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EDITOR'S CORNER

The editors recently received a letter from the Fish and Wildlife Service of the Department of the Interior suggesting that it might be helpful if we advise *CPN* readers on current rules and regulations concerning trade in protected carnivorous plants (CP).

There are two main legal and legislative concerns: 1) the U.S. Endangered Species Act (ESA), which deals with interstate, and to some extent international, shipments of listed plants (currently, only *S. oreophila* is listed among CP); and 2) the Convention of International Trade in Endangered Species (CITES), which covers international shipments of listed plants (currently, *Nepenthes rajah, Darlingtonia, Sarracenia rubra alabamensis, S. rubra jonesii* and *S. oreophila* are the CP listed). Of course, both lists are likely to be added to, and one country or another may add additional species of its own or other countries.

The laws for ESA indicate that *inter*state "trade" is forbidden without permits by the seller who must prove cultivation. "Trade" means for profit; donations and private exchanges are excluded, although bartering is not – there is likely a fine line between "barter" and "exchange" which might be individually interpreted by any single enforcement officer or district (as are the IRS laws!).

The rulings also cover plant products which of course would include seeds and cuttings and roots. However, seeds may be excluded if collected from cultivated plants, *but* proof of such cultivation must be available.

The above is the briefest of summaries, and as the reader can see, the situation is complex. All interested individuals should obtain pamphlet FWS-F-018 from the address mentioned below.

You should also request a list of plants involved at the same time.

So, within the United States, it is up to the dealer to have a permit to sell his plants interstate if he is dealing in listed CP. The buyer is not legally liable. Internationally, *both* dealer and customer will be required to have proper permits, and often special permits in addition that might be required by an individual nation. Those exchanging plants *inter*state or internationally not for profit are advised to read the pamphlet carefully and use caution.

As we mentioned, the situation is complex and there are many exceptions and amplifications of the above "bare bones" that those who exchange, donate, buy or sell CP must be aware of. Further, there are already contradictions among bureaucrats on interpretation. In future issues of *CPN* where we list sources as a reader service (we do not endorse any commercial source), or in the reader "want ad" section, we will put in a line or two reminding the reader to check into various restrictions.

For further completely detailed information and plant lists, write to: Federal Wildlife Permit Office, P.O. Box 3654, Arlington, VA 22203; telephone (703) 235-1903.

(DES)

SPECIAL NOTICE

Carnivorous Plants of the World, by K. Kondo, will be published in May, 1983. The soft-bound book will have 220 pages, 176 in color, and will illustrate 40% of the carnivorous plants in the world. Portions of the descriptions will be in English.

Joe Mazrimas has arranged with the author to compile orders from ICPS members. Orders should be sent to Joe Mazrimas (address inside front cover) by June 15, 1983. The price of $10.00 U.S. includes shipping. Checks or money orders should be made payable to Joe.

SEED BANK

Patrick Dwyer (St. Michael's Episcopal Church,
49 Killean Park, Albany, NY 12205)

To send seed: Please remove seed from the seed capsules and place it in small envelopes (preferably paper so that they dry out enough to prevent mold). Label with the origin and date of collection, including habitat if it is exotic. Fold the envelope once or twice before taping so that the seeds don't stick to the tape. After the seed is received it will be placed in smaller packets; donors will be informed of how many packets they have donated. A donation of 10-19 packets earns one free seed packet of comparable rarity, with one additional free packet for each additional 10 packets.

Do not ask to trade for seed from the bank. Everyone will have to buy all but the free packets.

To order seed: Please enclose payment. List the seeds desired and an equal number of substitutes in order of preference. If requested, Patrick will add any cultural instructions of which he is aware. Each issue of CPN will include an update of the inventory. Cost per packet: $.75. (Number of packets is listed if less than 15 are available.)

Byblis gigantea (10), *B. liniflora* (13), *Dionaea muscipula, Drosera acaulis* (2), *D. adelae* (1), *D. alba* (2), *D. aliciae* (5), *D. auriculata, D. brevifolia* (1), *D. burkeana* (8), *D. burmanii* (10), *D. capensis, D. capensis* (narrow), *D. capillaris* (15), *D. cistiflora* (1), *D. dielsiana* (7), *D. communis* (3), *D. erythrorhiza* (1), *D. filiformis* (5), *D. indica* (3), *D. intermedia, D. linearis* (1), *D. lovellae* (5), *D. montana* (3), *D. natalensis* (3), *D. nitidula* (1), *D. peltata, D. pygmaea* (15), *D. rotundifolia, D. spathulata, D. spath.* (Formosa) (2), *D. spath.* (Kansai), *D. spath.* (white fl.) (5), *D. trinervia* (3), *Nepenthes gracilis, N. khasiana, N. macfarlanei* (3), *N. mirabilis, N. rafflesiana* (3), *N. reinwardtiana* (7), *Pinguicula alpina, P. caerulea* (15), *P. corsica, P. grandiflora* (5), *P. grandiflora pallida, P. grandiflora rosea, P. lutea* (4), *P. primuliflora* (3), *P. vulgaris, P. vulgaris bicolor, Sarracenia flava, S. leucophylla, S. minor* (Okeefenokee) (2), *S. oreophila* (1), *S. purpurea purpurea, S. purpurea venosa* (6), *S. rubra* (2), *S. rubra wherryi* (15), *S. alata* × *minor* (1), *S. flava* × *leuco* (1), *S. leuco* × *alata* (10), *S. psittacina* × *minor* (6), *S. rubra* × *leuco* (10), *Utricularia bifida* (1), *U. capensis* (8), *U. lateriflora?* (4), *Uyakumensis* (2), *U. subulata* (10).

News and Views

O. CLYDE BRAMBLETT (18950 S.W. 136th St., Miami, FL 33187) writes: The Fairchild Tropical Garden Rambler went very well. Mr. Ron J. Pratt, Mr. Craig Johnson, my son Alan, and I put the entire CP exhibit in. We used 175 plants of which 49 were *Nepenthes* and included 22 different species and hybrids. The Ramble was attended by 7000 visitors who spent $79,000 to support the gardens. It seemed to all of us that all 7000 people dropped by the CP booth. We handed out many applications for membership in the ICPS as well as copies of sources of CP published by CPN. Some of the nurseries will probably be hearing from these people. All in all, it was a lot of fun and introduced a lot of people to CP who never knew there were any other than V.F.T.'s. We also had species and hybrids of *Byblis, Cephalotus, Utricularia, Drosera, Sarracenia* and *Pinguicula*.

In an earlier communication, Clyde Bramblett writes: I noticed the picture of *U. cornuta* in the back cover of the March *CPN* and I thought you might enjoy a snapshot of the plant growing in the Everglades not far from my place. Did you know it grows this well so far south in limestone rock and soil?

(Unfortunately, the photos would not reproduce well in CPN.—Ed.)

LEONARD DOLATOWSKI, JR. (3524 Highland Dr., Island Lake, IL 60042) sent

in a note describing his outdoor growing system in the northern Illinois area. For the past three years he has been growing plants as follows. He sunk a four-foot child's wading pool into the ground to the rim and filled it with 80% peat, 10% sand and 10% garden soil. He is growing *Sarracenia minor, S. flava* and *S. purpurea* ssp. *purpurea* along with two terrestrial orchid species. Even after cold northern winters, all plants are doing very well.

From RON GAGLIARDO (1216 Cooper Dr., Raliegh, NC 27607): The Eastern Carnivorous Plant Growers are invited to meet Sat., May 28, at Coleman's Nursery and Greenhouses, Virginia Beach, VA. All interested CPers are invited from 1 to 4 p.m. to listen to a variety of speakers and to make future plans. For more information, send a long, self-addressed envelope to Jim Powell, 2524 Denning Lane, Virginia Beach, VA 23321.

MICHAEL HOMICK (R.R. 2, Tillsonburg, Ontario, Canada N4G 4G7) writes: I have had an avid interest in carnivorous plants since 1970, when my high school teacher told me he thought there were other types of insect-eating plants besides the well-known 'Venus' Fly Trap'. Since that time, thanks mainly to *CPN*, I have discovered the exciting world of these curiosities.

I grow my plants in a 14′ × 20′ greenhouse. Although the rate of growth and development is markedly slowed during the winter months, my plants are most appreciated now for they are an escape from the cold winters.

Many times I have been asked why I am growing carnivorous plants by the 'unenlightened'. If I were to tell them I grow orchids, there would be no further requirements to elaborate why for an orchid plant covered in beautiful flowers would spring to mind, but carnivorous plants? Although their beauty may be lost to many, I can see new wonders always.

To facilitate in the pollination of *Byblis liniflora* I purchased an electric pencil engraver used to mark items for protection against theft. The vibrating tip upon coming in contact with the flower results in a cascade of pollen from the anthers to the stigma. With the aid of the engraver many flowers can be pollinated in a very short period of time.

I have found that *Byblis liniflora* seed require a dormancy period before they will germinate quickly. I have tried to sow seed immediately after they have been released from the seed capsule but the seed will just sit there for a long time before initiating growth. If the seed has been stored in the refrigerator and then sowed they will germinate very quickly.

LARRY MELLICHAMP published an article on *Darlingtonia* which will appear in the February 1983 issue of *Natural History Magazine*. The photos were taken by someone else.

METIN A. SAVIGNANO (Muhlrain 26, 7000 Stuttgart 1, Fed. Rep. of Germany) informs us as secretary of a new CP society, he is inviting all German-speaking *CPN* readers to also join his group. He intends to publish a German version of *CPN* which will have articles submitted in the German language from Germany, Austria and Switzerland. A few articles from our English version will be translated into German to get them started. We wish them luck on their new adventure. This may be the first time after 11 years that a foreign-language version of *CPN* will be published.

DON SCHNELL (Rt. 1, Box 145C, Pulaski, VA 24301) reports on a news item circulating among North Carolina newspapers in late October, 1982. The article concerns a German pharmaceutical company called Carnivora and run by Erwin Machtel and his son Thomas, who claim to have arrested experimental cancers in cheek pouches of hamsters (the tumor having been artificially induced with a carcinogen) using injections of extract from *Dionaea*. As a result, the firm is seeking to obtain 10,000 seeds and 50,000 plants of *Dionaea* for further research which is patented in Germany. It is unclear from

where the seeds will come, but the plants will come from a "Chapel Hill grower." Apparently only 12 hamsters were tested, and the exact methodology and type of results are unclear, as expected in a lay newspaper report. However, the company is apparently applying for permission to begin human research in Germany based on their preliminary results. A spokesman for the American Cancer Society expressed deep reservations since no scientific literature has yet appeared on this.

SUSAN SIKES (180 N. 4th St. 501, San Jose, CA 95112) writes: In N&V of *CPN* for June, 1980 (Vol. 9, No. 2), Mr. John B. Burns describes how to make a pot with a domed cover from a two-liter soft drink bottle. These are very useful for some species of CP but too shallow for many others.

May I make another suggestion? Drill several small holes in the top of the dome to give some circulation of air to the plants, especially if they are exposed to direct sunlight for any length of time. My CP are grown on a windowsill with eastern exposure. Most plants are in 4-inch plastic pots with a cover made from the largest size clear plastic Solo cup (16 oz.). Before inverting over the plants, I drill 6 holes (⅛" in) in the bottom. This way, each plant lives in its own "little ventilated greenhouse." Large clear plastic food containers (with holes) are used on the larger pots.

Since retiring, I have found that raising CP is an interesting hobby. Thanks to the editors for giving us such an interesting and helpful little magazine.

SPECIAL NOTICE

Members who have not returned the pink ICPS information sheet are requested to do so. If you have not received one, or if you have misplaced yours, please notify Pat Hansen (address inside front cover), and one will be included with your next *CPN*.

Members who have not received by-laws should request them from Pat Hansen.

ISAMU KUSAKABE (5-14-6 Chitosedai, Setagaya, Tokyo, 157 Japan) reports: In recent correspondence with Mr. Marcel Lecoufle of France, the following information was revealed about *Nepenthes* hybrids: *Nepenthes* × *lecouflei*, hyb.nov. = (*N. mirabilis* × *N. thorelli*). According to Lecoufle, these plants were introduced into cultivation from Cambodia, and identified as *N. kampotiana* Lecomte by the Museum of Paris. The above named hybrid was accidentally mixed in them and erroneously sold under the species name. Mr. Lecoufle accepted the hybrid name with pleasure. The color of the herbarium specimen deposited as #NDC-6375 at the Nippon Dental College in Chiyoda-ku, Tokyo was pale brown but *N. kampotiana* is black.

Two more hybrids were presented by Mr. Lecoufle to the Plants Committee of the Royal Horticultural Society in London on the 14th of July, 1981 and are as follows:

Nepenthes × 'Ile de France' = N. × lecouflei × mixta (var. sanguinea)

Nepenthes × 'Ville de Rouen' = N. × superba × N. × mastersiana

This latter plant has been raised by Mr. Yvon Vezier, Botanic Gardens of the town of Rouen in 1978.

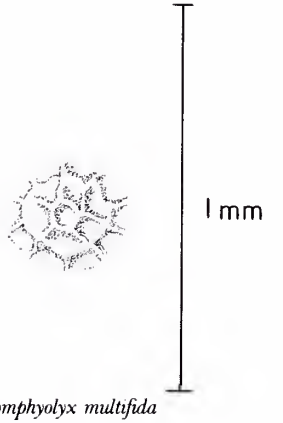
Nepenthes × *lecouflei*, erroneously sold as *N. kampotiana* (photo: M. Lecoufle).

STEVE SMITH (1159 Trim St., Kirkwood, NY 13795) writes: A couple of years ago I wrote in N&V that I was experimenting with tannic acid to retard algae growth in acquatic mediums. Well, it turned out not to do the job properly. I am happy to report that I have found a product that does kill algae with no harm to *Aldrovanda*, and I am reasonably sure it will do no harm to Utrics, either. It is a product called Acurel E. It can be purchased from Lilypons Water Gardens, Lilyponds, MD 21717 at a cost of $6.95 plus a small shipping charge. Credit card orders may be placed toll free to 800-228-2028, ext. 153. I am growing *Aldrovanda* now for the longest period of time with NO algae problems. The label does not list the proper dose for small aquariums. I have been using a dilution of 4 drops per gallon. If there is algae already in the water it may turn purple for a while, but in time will clear, and it does no harm to the plant life. I am also experimenting with using the same product to kill algae on soil, but to date have had no success.

Several of my Mexican Pings became infested with aphids this summer. As you well know, it is very hard to get to the underside of these plants, so I set about trying to figure out how to accomplish extermination of these little suckers. My solution was to prepare a one-quarter strength solution of Malathion and pour into the bottom of a large bucket. The amount to mix will vary as to the size of the plant to be disinfected, but enough must be mixed to completely submerge the plant. The plant is then submerged for a period of 30 seconds, then lifted out and allowed to drain. Do this weekly for two or three weeks and the aphids will disappear, with no ill effects to the plants. I have used the same treatment on *D. schizandra* and many other *Drosera* with no more ill effects than causing the tentacles to bend. While dunking the plants it is very important to wear rubber gloves so the poison is not absorbed into your skin. You may want to pass these items on to readers of *CPN*. I have also had several correspondents ask what kind of sand I use in my peat/sand mixes. I have found that sandblasting sand #1 works excellently and is readily available from many building supply houses for under $5.00 per 100-lb. bag.

JEANNIE WILSON, botanist at the Hampton Mariners Museum (120 Turner St., Beaufort, NC 28516) sent in the following observation: While leading a botanical excursion in the Croatan National Forest in June of 1982, I noticed the abundance of seeds on *Dionaea muscipula*. So I collected about 20 seeds to germinate for use in educational programs. Having no container available for seeds, I placed them with the flowering stalk in an empty film can attached to my camera. I'm embarrased to say that I forgot about them when I returned from the trip. A few weeks later, when I led another trip to the Croatan, I opened the film can looking for a fresh roll of film. It was certainly a surprise to find a can full of sprouts. Apparently, there was just enough moisture in a dark location to hasten germination. An interesting experiment wuld be to try germinating other small seeds in empty film containers. I would be interested to know if anyone else has used this method for seed germination.

(Film cans usually seal tightly when closed and probably prevented evaporation of moisture from still-green pedicels and flower receptacles.—Ed.)



Polypomphyolyx multifida

Polypompholyx multifida (R.Br.) F. Muell. – spherical, heavily ridged in reticulate pattern, diameter around 0.4 mm, brown. See article, next page. Drawing by D. Tolman.

SEED STRUCTURE OF CARNIVOROUS PLANTS

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This report is the beginning of a study of the seed structure of carnivorous plants. For several years I have noticed that when one receives seed of a carnivorous plant one can't usually tell if the seed is from the plant that it is supposed to be from. There is usually no way of checking the species from the seed alone. The seed of most genera have not been studied extensively. However, the *Utricularia* of West Bengal and *Drosera* of North America have been drawn and studied extensively. Regional keys for these genera have been made. Seed of *Utricularia* of other areas has also been used to a great extent by Peter Taylor in distinguishing between species.

I decided this year to start drawing all of the seed that I had and to try to obtain as many more kinds as I could, so that these could be drawn too. I also have tried to collect as many descriptions of seed as I could find. Eventually I would like to combine all of the information known into one research paper. Also, I think that someday any seed of a carnivorous plant will be able to be keyed down by itself to the species or even the variety.

Materials and Methods

To start this project I have drawn all the seeds that I have obtained so far.* I also obtained as many descriptions of seed as I could find from various publications.

The seeds were first observed under a dissecting microscope. Then they were observed with a compound microscope using higher magnification. To view the opaque seeds with a compound microscope effectively, side lighting was used. The seeds were not soaked in water or pretreated in any way. The seeds were drawn to scale in pencil and later drawn over in black ink.

After making drawings of the exterior structure of seed, I dissected seed of each family that I had. I took the seed coat off the seed and stained it with I_2KI. The I_2KI stained the starch in the endosperm. I also took cross sections of seed and stained them with I_2KI as well. Utilizing these observations and those of others, I have made a key to distinguish between seeds of most of the genera of carnivorous plants.

In order to get information on seeds of carnivorous plants I used Lynn Macy's KWIC bibliography service and the library of SUNY at Albany. Many articles were obtained through the interlibrary loan service of SUNYA. In these publications I looked for descriptions of seed which are now included in this report.

Results

The seeds of carnivorous plants are quite different in their structure and morphology. The major difference between seeds of carnivorous plants is presence or absence of endosperm. The Family Lentibulariaceae (*Utricularia, Polypompholyx, Genlisea,* and *Pinguicula*) has no endosperm that can be readily seen in mature seed. All other carnivorous plant seeds have endosperm. In the Lentibulariaceae *Pinguicula* seed can be separated easily from the other three genera by external seed structure. All *Pinguicula* seed is scobiform. The other three genera have to be distinguished from each other by internal structure at this time. I think that they probably are different externally, too. The different species of *Utricularia* have seed of many different shapes and sizes. As a result I feel that all of these should be described before *Polypompholyx* and *Genlisea* are

*Patrick Dwyer's drawings could not be reproduced well; the drawings appearing with the article were done by Debbie Tolman and John Randall, students at the Univerty of North Carolina at Charlotte, from seed specimens sent to them by Patrick Dwyer. The caption information is from Patrick Dwyer.

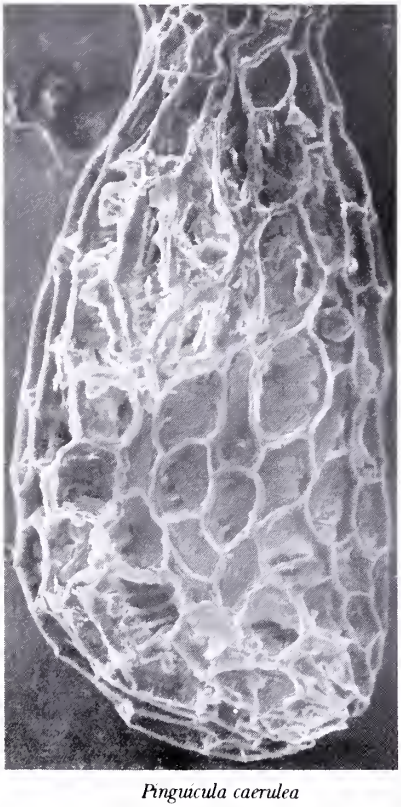
distinguished from them on external characters. In other words, they are too complex to generalize yet.

Among other carnivorous plants, *Drosera* is the largest group with the most variety between species. A small basal embryo in *Drosera* may be a difference from *Byblis* if *Byblis* does not have it. The differences between *Dionaea, Drosophyllum, Sarracenia, Darlingtonia, Heliamphora, Byblis* and *Nepenthes* are basically external characteristics and size. I really don't have enough information on *Cephalotus* to even include it in the key.

Within the genera the seeds that are hardest to distinguish between species are those of *Sarracenia* and *Nepenthes*. The seed of all of the species of *Sarracenia* are very similar. The structural characteristics and sizes of seed overlap from species to species. Donald Schnell informed me that the seeds of *Sarracenia* species vary in color, size, shape and external markings from season to season, and with the environmental factors that affect the plant. Dr. Baum suggested that perhaps there might be some colored chemical reactions which might distinguish the species of these seed. I was unable to find any reactions specific enough to be useful. However, I think this should be looked into further.

The other seed that I studied show differences in structure, size, or color from species to species. The *Utricularia, Polypompholyx, Drosera, Byblis,* and *Pinguicula* seeds all are distinguishable from species to species. *Pinguicula* seed is the hardest of these genera. They all look similar and have the same basic shape. Here size and color are more important than in the other genera.

I hope to study seeds of *Cephalotus* and *Heliamphora*, as well as more seed of the genera already listed. Maybe I will be able to get *Genlisea* and *Aldrovanda* seed also.



Pinguicula caerulea
Mag. 50×

Pinguicula caerulea
Mag 500×

SEM photomicrographs sent by Tom Story, 1112 Klengel St., Antioch, CA 94509.

KEY TO THE GENERA OF CARNIVOROUS PLANT SEED

1. Seed with endosperm, positive indication with I_2KI – (Sarraceniales) – 2.

I. Seed without apparent endosperm, negative indication with I_2KI – (Lentibulariaceae) – 9.

2. Seed coat elongated at both ends, filiform, length usually greater than 5 mm (3 mm is smallest) – *Nepenthes*.

2. Seed coat not elongated at ends, ovoid or obovoid; with only small extensions of seed coat, or none – 3.

3. Seed winged, wings circling around the seed – *Heliamphora*.

3. Seed not winged – 4.

4. Seed with small projections or extensions of the seed coat, seed length around 3 mm – *Darlingtonia*.

4. Seed without projections if around 3 mm in length or seed smaller than 3 mm – 5.

5. Seed pyriform (pear-shaped) with thick wrinkled black seed coat, length about 3 mm – *Drosophyllum*.

5. Seed with a smooth coat or smaller than 3 mm – 6.

6. Seed ovate to pyriform with smooth black seed coat with minute pits, length about 3 mm – *Dionaea*.

6. Seed smaller than 3 mm in length – 7.

7. Seed obovoid, areolate and sometimes tuberculate or bullate, length 1.1 mm – 2.5 mm, color from grey to brown, *Sarracenia*

7. Seed variously shaped, reticulate, papillose, pitted or smooth, color from brown to black, length from 0.25 mm – around 3.0 mm – 8.

8. Seed with basal embryo – *Drosera, Aldrovanda.*

8. Seed without basal embryo (? – this has not been seen or checked) – *Byblis*.

9. Seed length greater than width – often cylindrical or fusiform, the surface reticulated or pitted – *Pinguicula*

9. Seed variously shaped, sometimes winged, if cylindrical or fusiform then not reticulate or pitted. (This statement is based on a very small number of species. It may prove wrong with further investigation) – *Genlisea, Polypompholyx, Utricularia.*

The following differences between the genera of Lentibulariaceae were not observed by me. I attempted to see these features using tetrazolium stain. I will try again when I become more proficient with this chemical. All of these characteristics were found in the article by Farooq.

Pinguicula – embryo differentiated with root primodia, no micropylar endosperm haustorium (MEH), no nutritive tissue (endosperm) present.

Genlisea – embryo differentiated without root primordia, MEH within integument, nutritive tissue present (minute amount).

Polypompholyx – embryo undifferentiated, MEH enters funicle, nutritive tissue present (minute amount).

Polypompholyx – embryo undifferentiated, MEH enters funicle, nutritive tissue present (minute amount).

Utricularia – embryo undifferentiated, MEH is extra ovular, nutritive tissue is a single layer of cells between embryo and seed coat.

The following are descriptions that I found. Seed was drawn in many articles;

in some there was no description. I did not include those without written descriptions.

Aldrovanda vesiculosa L. (Europe, India, Japan, Africa) – minute, ellipsoidal, shining with a mucro at base, black (Ohwi, 1965).

Drosera affinis Welw. ex Oliver (Trop. Africa) – fusiform, testa reticulate with longitudinal and transverse ridges, 0.7-0.9 mm long and 0.2 mm broad (Laundon, 1959).

D. banksii R. Br. (Australia) – ovoid, about 1 mm long, black (Erickson, 1968).

D. binata Labill. (Australia, New Zealand) – linear with expanded membrane on each side (Erickson, 1968).

D. burkeana Planch. (S. Africa) – ovoid, testa smooth, 0.3-0.4 mm long and 0.15-0.2 mm broad, black (Laundon, 1959).

D. colombiana Fernandez-Perez (Colombia) – obovate to ellipsoid, base narrow, wrinkled, 0.4 mm long (Fernandez-Perez, 1965).

D. communis St. Hil. (Brazil, Colombia) – fusiform, 0.8-1.2 mm long and 0.3 mm wide (Fernandez-Perez, 1965).

D. emissa Diels. (Australia) – pitted and almost football shaped, grey (Erickson, 1968).

D. felix Steyermark & Smith (Venezuela) – ovoid, about 0.4 mm long and 0.2 mm wide (Steyermark & Smith, 1974).

Drosera fimbriata DeBuhr (Australia) – small, ovoid black (DeBuhr, 1975).

D. heterophylla Lindl. (Australia) – linear, curved in with a crook at one end (Erickson, 1968).

D. macrantha Lindl. (Australia) – linear (Erickson, 1968).

D. macrophylla Lindl. (Australia) – very small and round, black (Erickson, 1968).

D. madagascariensis D.C. (Madagascar, Trop. Africa) – fusiform, testa reticulate with longitudinal and transverse ridges, 0.7-0.9 mm long and 0.2 mm broad (Laundon, 1959).

D. marchantii DeBuhr (Australia) – linear, about 1 mm long, black (DeBuhr, 1975).

D. neesii Lehm. (Australia) – narrowly linear (Erickson, 1968).

D. paleacea D.C. (Australia) - striped and almost round (Erickson, 1968).

D. petiolaris R.Br. ex D.C. (Australia) – ellipsoid with small warts on each side (Erickson, 1968).

D. peltata var *nipponica* (Masam) Ohwi (Japan) – broadly elliptic, slightly attenuate at both ends, about 0.5 mm long with fine longitudinal and obsolete cross lines (Ohwi, 1965).

D. pilosa Exell et Laundon (Cameroons, Kenya, Tanzania) – ovoid, testa smooth, 0.3-0.5 mm long and 0.2 mm broad, black (Laundon, 1959).

D. platypoda Turcz. (Australia) – round, angled, and warty (Erickson, 1968).

Drosera pulchella Lehm. (Australia) – ellipsoid with minute dots and grooves, black (Erickson, 1968).

D. pusilla H.B.K. (Venezuela) – subglobose (Fernandez-Perez, 1965).

D. stricticaulis (Diels) O.H.S. (Australia) – broad and flat, curved like a flattened bean with a furrow along the middle of each side (Erickson, 1968).

D. sulphurea Lehm. (Australia) – narrowly linear (Erickson, 1968).

D. tenella H.B.K. (Argentina) – oblong (Fernandez-Perez, 1965).

D. whittakerii Planch. (Australia) – round and pitted, black (Erickson, 1968).

Cephalotus follicularis Labill. (Australia) – small, oval shaped, light brown (Mazrimas, 1976).

Heliamphora species Benth. (Venezuela) – large wing developed around seed (Uphof., 1936).

Nepenthes alata Blanco. (Philippines) – filiform, 8-10 mm long, nucleus with transverse wrinkles (Danser, 1928).

N. albo-marginata Lobb. (Malaysia, Sumatra, Borneo) – filiform, 15-22 mm long, nucleus transversely wrinkled (Danser, 1928).

N. ampullaria Jack. (Malaysia, Sumatra, Borneo, New Guinea) – filiform, 10-15 mm long, nucleus with minute prickles, slightly longitudinally wrinkled (Danser, 1928).

Nepenthes bongso Korth. (Sumatra) – filiform, 6-12 mm long, nucleus longitudinally

but hardly transversely wrinkled (Danser, 1928).

N. boschiana Korth. (Borneo) – filiform, about 12 mm long (Danser, 1928).

N. decurrens Macf. (Borneo) – up to 15 mm long (Danser, 1928).

N. ephippiata Dans. (Borneo) – filiform, 10-15 mm long, nucleus tuberculate-wrinkled (Danser, 1928).

N. gracilis Korth. (Malaysia, Sumatra, Borneo, Celebes) – filiform, 9-15 mm long, nucleus delicately prickly (Danser, 1928).

N. gracillima Ridl. (Malaysia) – filiform, about 8 mm long, nucleus strongly transversely wrinkled (Danser, 1928).

N. gymnamphora Nees (Sumatra, Borneo, Java) – filiform, 6-15 mm long, nucleus usually indistinctly transversely wrinkled (Danser, 1928).

N. hirsuta Hook. (Borneo) – filiform, 12-20 mm lng, nucleus transversely wrinkled (Danser, 1928).

N. maxima Nees. (Borneo, Celebes, Moluccas, New Guinea) – filiform, 10-20mm long, nucleus delicately transversely wrinkled (Danser, 1928).

N. mirabilis Druce. (Widespread over S.E. Asia and E. Indies) – filiform, about 12 mm long, nucleus slightly wrinkled and slightly prickled (Danser, 1928).

Nepenthes papuana Dans. (New Guinea) – filiform, 12-15 mm long, nucleus transversely wrinkled (Danser, 1928).

N. pectinata Dans. (Sumatra) – filiform (Danser, 1928).

N. rafflesiana Jack. (Malaysia, Sumatra, Borneo) – filiform, 10-12 mm long, nucleus and adjacent part of appendages delicately and shortly prickled (Danser, 1928).

N. rajah Hook. (Borneo) – filiform, 3-8 mm long, nucleus not or slightly wrinkled (Danser, 1928).

N. reinwardtiana Miq. (Malaysia, Sumatra, Borneo, Moluccas) – filiform, nucleus transversely wrinkled (Danser, 1928).

N. sanguinea Lindl. (Malaysia) – filiform, 12-15 mm long, nucleus strongly transversely wrinkled (Danser, 1928).

N. singalana Bec. (Sumatra) – filiform, 8-12 mm long, nucleus strongly transversely wrinkled (Danser, 1928).

N. spectabilis Dans. (Sumatra) – filiform, 12-18 mm long, nucleus strongly transversely wrinkled (Danser, 1928).

N. tobaica Dans. (Sumatra) – filiform, 8-15 mm long, nucleus transversely wrinkled (Danser, 1928).

N. treubiana Warb. (Sumatra, New Guinea) – filiform, nucleus transversely wrinkled (Danser, 1928).

N. veitchii Hook. (Borneo) – filiform, nucleus strongly transversely wrinkled (Danser, 1928).

N. villosa Hook. (Borneo) – filiform, 8-9 mm long (Danser, 1928).

Genlisea filiformis St. Hil. (Brazil, Venezuela, Guyana, Cuba, Colombia, Br. Honduras) – subpyramidal, 0.2 mm long, light brown (Fernandez-Perez, 1964).

Pinguicula agnata Casper (Mexico) – scobiform, cylindrical, alveolate (Casper, 1966).

P. albida Wright ex. Griseb. (Cuba) – scobiform, conical, ± 0.5 mm long and ±0.2 mm wide, reticulated (Casper, 1966).

P. antarctica Vah. (Chile, Argentina) – scobiform, cylindric-fusiform, 0.6-0.8 mm long and 0.2-0.26 mm wide, alveolate (Casper, 1966).

P. balcanica Casper (Bulgaria, Yugoslavia, Albania, Greece) – scobiform (Casper, 1966).

P. caerulea Walt. (N.C., S.C., Ga., Fla. – U.S.A.) – scobiform, oblong-conical ±0.5 mm long and 0.2-0.3 mm wide, alveolate (Casper, 1966); oblong or obpyramidal alveolate with 3-4 cross lines (Godfrey & Stripl., 1961).

P. calyptrata H.B.K. (Colombia, Ecuador) – scobiform, ellipsoid, alveolate (Casper, 1966).

P. chilensis Clos. (Chile, Argentina) – scobiform (Casper, 1966).

P. cladophila Ernst. = *P. casabitoana* Jimenez. (Cuba) – ellipsoid to fusiform, inauspicious, up to 1 mm long and 0.3 mm wide, with branches 1.5 mm long filled with complex irregularities (Casper, 1966).

Pinguicula colimensis McVaugh & Mickel (Mexico) – scobiform, minute (Casper, 1966).

P. crenatoliba D.C. (Mexico, Guatemala,

Honduras, El Salvador, Panama) – scobiform, ellipsoid, ±0.3 mm long and ±0.2 mm wide, alveolate (Casper, 1966).

P. crystallina Sibth. ex. Sibth. et Smith. (Cyprus) – scobiform (Casper, 1966).

P. cyclosecta Casper (Mexico) – scobiform (Casper, 1966).

P. elongata Benj. (Venezuela, Colombia) – scobiform, fusiform, 0.8-1 mm long and 0.2-0.27 mm wide, alveolate (Casper, 1966).

P. filifolia Wright ex. Griseb (Cuba) – scobiform, ±0.5 mm long, ±0.2 mm wide, reticulated (Casper, 1966).

P. heterophylla Benth. (Mexico) – scobiform, fusiform, oblong, ±1 mm long, ±0.55 mm wide, alveolate (Casper, 1966).

P. hirtiflora Ten. (Italy, E. Mediterranean) – scobiform, 0.5-1 mm long and 0.2-0.3 mm wide, alveolate (Casper, 1966).

P. involuta Ruiz et Pav. (Bolivia, Peru) – scobiform, ellipsoid, 0.4-0.6 mm long and 0.2-0.25 mm wide, alveolate (Casper, 1966).

P. jackii Barnh. (Cuba) – scobiform, ellipsoid, ±0.75 mm long and ±0.5 mm wide, verucose (Casper, 1966).

P. lignicola Barnh. (Cuba) – ellipsoid to fusiform, up to 0.5-0.8 mm long and 0.3 mm wide, with branches ±2 mm long filled with complex irregulates (Casper, 1966).

Pinguicula lilacina Schlecht et Cham. (Mexico) – scobiform, fusiform, 0.5-0.6 mm long and 0.2-0.25 mm wide, alveolate (Casper, 1966).

P. longifolia Ram. ex. D.C. (Spain, France, Italy) – scobiform, cylindrical, ±1 mm long and ±0.2-0.4 mm wide, alveolate (Casper, 1966).

P. moranensis H.B.K. (Mexico, Guatemala, El Salvador) – scobiform (Casper, 1966).

P. nevadensis (Lindbg.) Casper (Spain) – scobiform (Casper, 1966).

P. parvifolia Robinson (Mexico) – scobiform, alveolate (Casper, 1966).

P. ramosa Mijoshi ex. Yatabe (Japan) – scobiform (Casper, 1966).

P. variegata Turcz. (Siberia) – scobiform (Casper, 1966).

P. villosa L. (N. Boreal) – scobiform, reticulated (Casper, 1966).

Utricularia adpressa Salzm. ex. St. Hil. et Gir. (Br. Honduras, Venezuela, Guyana, Brazil, Trinidad) – globose with ± isodiametric reticulation (Taylor, 1967).

U. andongensis Hiern. (Guinea to Zambia and Angola) – verrucose, ovoid (Taylor, 1954).

U. aurea Lour. (India to Australia, Japan) – tabular prismatic and polygonal with slightly winged margins usually 1-2 layers thick, 829.6 microns long and 829.6 microns wide (Abraham & Subr, 1965).

Utricularia baouleensis A. Chev. (Trop. Africa, Madagascar, India, Philippines, Australia) – obovoid, epidermal cells finely striated and scrobiculate, 329 microns long and 174.2 microns wide (Abraham & Subr., 1965).

U. bifida L. (India to Australia, Japan) – obovoid, epidermal cells prominently striated and reticulate ending in blunt projections, 405.5 microns long and 261.3 microns wide (Abrahams and Subr., 1965).

U. caerulea L. (India to Australia, Japan) – obovoid, epidermal cells not striated, 256 microns long and 147 microns wide (Abraham & Subr.,1965).

U. chiribiquitensis Fernandez (Colombia, Venezuela) – globuse with ± isodiametric reticulation (Taylor, 1967).

U. chrysantha R.Br. (Australia, New Guinea) – minute, shining, yellow (Erickson, 1968).

U. dichotoma Labill. (Australia) – small and ovoid (Erickson, 1968).

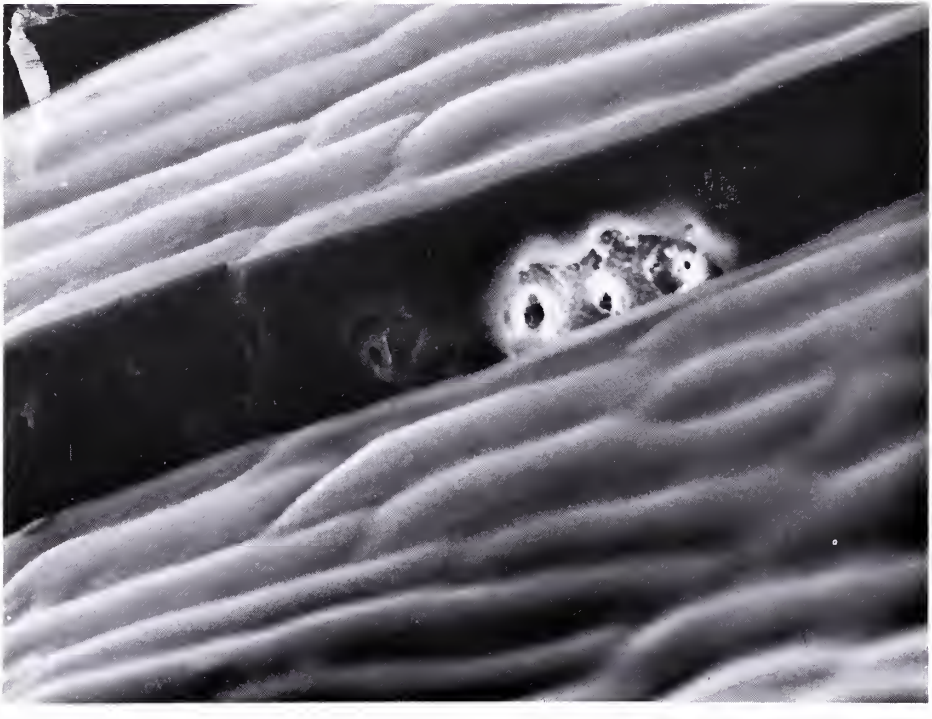
U. dimorphantha Makino (Japan) – angled with convex faces (Ohwi, 1965).

U. erectiflora St. Hil. & Gir. (Br. Honduras, Guyana, Venezuela, Brazil, Nicaragua, Colombia) – obliquely ovoid with prominent hilum, about 0.3 mm long, testa cells small and elongate (Taylor, 1975).

U. exoleta R. Br. (Africa to Australia, Japan, Spain, Portugal) – peltate bordered with a thin irregular wing (Erickson, 1968); lenticular with a crenulate corky wing, 1427 microns long and 1193 microns wide (Abraham & Subr., 1965).

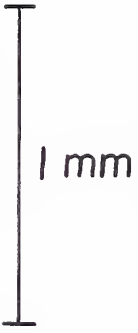
Utricularia fimbriata Kunth. (Colombia, Venezuela) – narrowly elliptical to globose, 0.2 mm long, transparent, brown (Fer-

(Text continued on page 19)



Dionaea muscipula Ellis Ex.L. (E. USA) – ovate to slightly pyriform, smooth shiny appearance with minute pits, around 3 mm in length, black.

Top: D. muscipula seed 75×. Bottom: 1200×. S.E.M. photos sent by Tom Story.



Byblis liniflora

Byblis gigantea

Drosophyllum lusitanicum

Drawings by Debbie Tolman

Byblis gigantea Lindl. (Australia) – irregularly ovate to elliptic, thick wrinkled seed coat, 1-1.5 mm, black.

Byblis liniflora Salisb. (Australia) – elliptic, reticulate seed coat, around 1 mm in length, black.

Drosophyllum lusitanicum Link. (Spain) – pyriform with a thick wrinkled seed coat, around 3 mm in length, black.

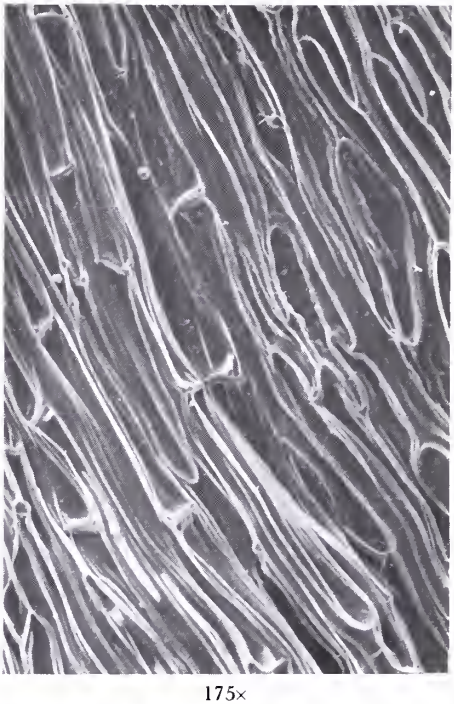
Drosophyllum lusitanicum
350×
photo sent by Tom Story

42×

210×

Darlingtonia californica

25×



175×

N. pervelli

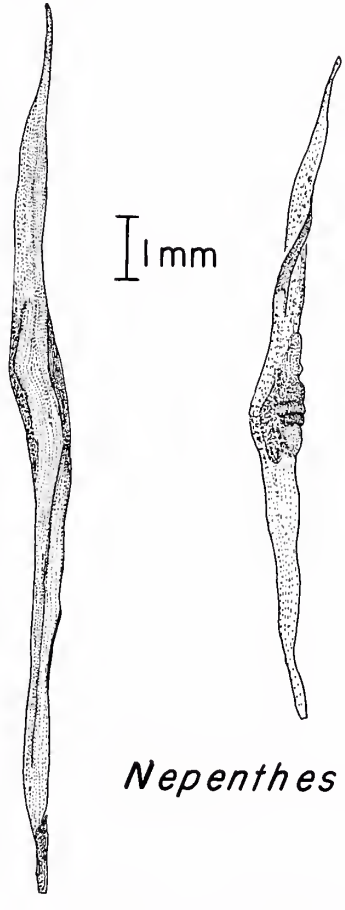
Photos sent by Tom Story

Left:
Darlingtonia californica Torr. (Ca., Oregon-USA) – elliptic with one end elongated and truncated, on the elliptic end there are long projections, seed length about 3.5 mm including projections, light brown.

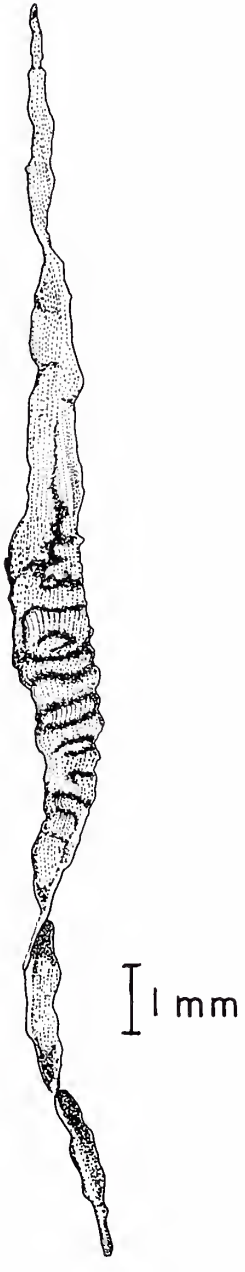
Below from left:
Nepenthes mirabilis Druce. (S.E. Asia to Australia) – filiform, longitudinally striated, length around 14 mm, brown.

Nepenthes ventricosa Blanco. (Philippines) – filiform, longitudinally striated, nucleus transversely wrinkled, seed around 10 mm in length, brown.

Nepenthes macfarlanei Hemsl. (Malaysia) – filiform, longitudinally striated, nucleus transversely wrinkled, seed around 19 mm in length, brown.



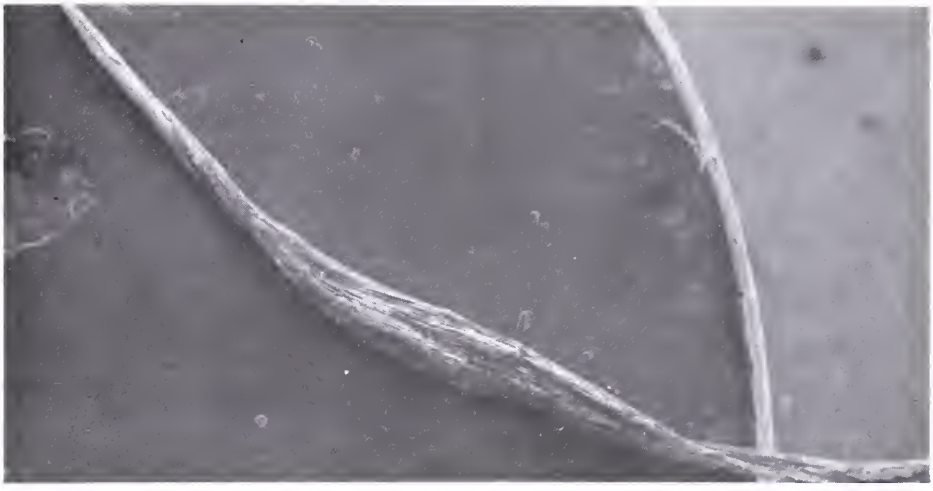
Nepenthes ventricosa



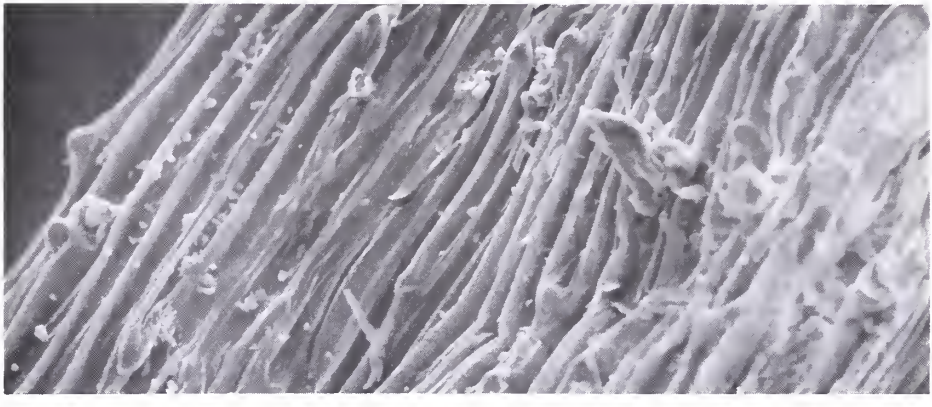
Nepenthes mirabilis

Nepenthes macfarlanei

Drawings by John Randall



Nepenthes khasiana 20×

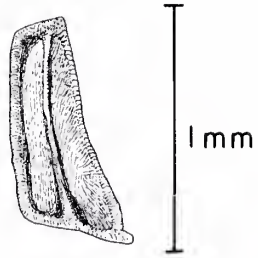


Nepenthes khasiana 400×

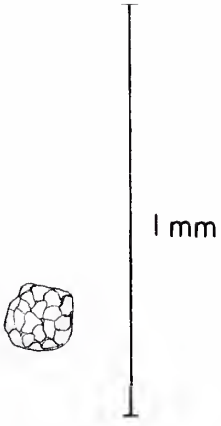
Nepenthes khasiana 4000×

Nepenthes khasiana Hook. (Assam, India) – filiform, longitudinally striated, length around 8 mm, dark brown.

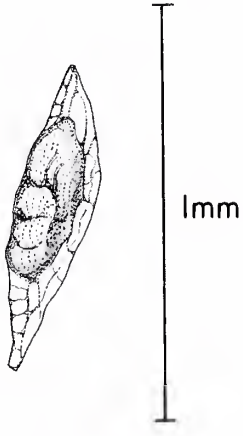
S.E.M. photos sent by Tom Story



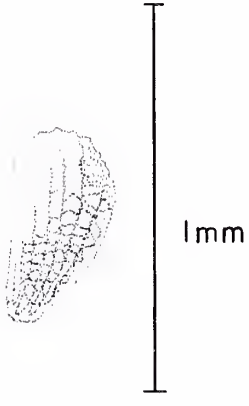
Utricularia longifolia



Utricularia nipponica



Utricularia endresii



Utricularia racemosa

Drawings by J. Randall and D. Tolman (*U. racemosa*)

Utricularia longifolia Gardn. (Brazil) – irregular, deltoid to oblong, heavily striated, length around 1.2 mm, winged, brown.

Utricularia nipponica = *Utricularia minutissima* Vahl. (India to Borneo, Australia, Japan, New Guinea) – minute, smooth, ovoid, wingless (Ohwi, 1965), reticulated, length around 0.1 mm, brown.

Utricularia endresii Reichb. (Central America – fusiform, three-angled, length around 1 mm, light brown.

Utricularia racemosa = *Utricularia caerulea* L. (India to Australia, Japan) – wingless (Ohwi, 1965), irregular, rhomboidal with striations, some shriveled, brown.

(Text continued from page 65)

nandez-Perez, 1964).

U. flexuosa Vahl. = *U. aurea* Lour. – flat and polygonal or almost circular (Khan, 1954).

U. foliosa L. (Florida to Argentina, Trop. Africa, Madagascar, Galapagos Islands) – lenticular, 2-2.5 mm in diameter with a narrow hyaline wing (Taylor, 1975).

U. fulva F. Muell. (Australia) – very small, ovoid (Erickson, 1968).

U. gibba L. (U.S.A.) – with a broad irregular

ring (Taylor, 1954).

U. hirta Klein ex. Link (India, Thailand, Indochina, Australia) – ovoid, seed coat without clavate projections and with a slightly wavy outline, 276.2 microns long and 207.5 microns wide (Abraham & Subr., 1965).

U. humboldtii R.H. Schomburgk (Venezuela) – circular, flat, with a reticulate hyaline wing (Taylor, 1967).

U. hydrocarpa Vahl. (Cuba to Brazil) – depressed globose, not winged (Taylor, 1967).

U. inflexa var. *stellaris* (L.) Taylor = *U. stellaris* L.F. (Trop. and S. Africa, Madagascar, Trop. Asia, Australia) – tabular, prismatic and polygonal with slightly winged margins usually 1-2 layers thick, 802.4 microns long and 802.4 microns wide (Abraham & Subr., 1965); prismatic, 0.5-0.7 mm wide, narrowly winged on all angles (Aston, 1973).

Utricularia jamesoniana Oliver (Ecuador, Guyana, Venezuela, Colombia, Antilles, Peru, Costa Rica, Panama) – narrowly cylindrical, about 0.3 mm long (Taylor, 1975).

U. juncea Vahl. (E. U.S.A., West Indies, Br. Honduras, Trinidad, N. Brazil, Colombia, Venezuela, Guyana) – subglobose, reticulated (Fernandez-Perez, 1964).

U. kimberleyensis Gardner. (Australia) – narrow and wrinkled (Erickson, 1968).

U. lateriflora R.Br. (Australia) – small, ovoid (Erickson, 1968).

U. leptoplectra F. Muell. (Australia) – twice (?) as long as broad, dark brown (Erickson, 1968).

U. micropetala Sm. (W. Trop. Africa) – ovoid, smooth with prominent hilium (Taylor, 1954).

U. multispinosa (Miki) Miki = *U. minor* L. (Europe, Asia, N. America) – winged, orbicular (Ohwi, 1965).

U. naviculata Taylor (Brazil, Venezuela) – lenticular (Taylor, 1967).

U. neottioides St. Hil. et Gir. (Brazil, Colombia) – elliptic (Fernandez-Perez, 1964).

U. nivea Vahl. = *U. caerulea* L. (India to Australia, Japan) – ovoid, seed coat with minute clavate projections, 223 microns long and 108.3 microns wide (Abraham & Subr., 1965).

Utricularia obtusa Sw. (West Indies, S. America, Trop. Africa) – more or less lenticular, about 1 mm wide with a pronounced hilium and an irregular corky wing (Taylor, 1975).

U. olivacea Wright ex. Griseb. (E. U.S.A., Cuba, Venezuela, Guyana, Brazil, Surinam) – not winged (Taylor, 1967).

U. pilosa (Makino) Makino (Japan, Korea) – obtusely 5 or 6 angled (Ohwi, 1965).

U. pubescens Sm. (Guyana, Venezuela, Colombia, Brazil, Trop. Africa, India) – smooth (Taylor, 1954).

U. pusilla Vahl. (Central and S. America, West Indies) – ovoid, about 0.35 mm long with about eleven longitudinal striations (Taylor, 1975).

U. pygmaea R.Br. (Australia) – dished in and winged about the edges (Erickson, 1968).

U. scandens Benj. (Trop. Africa, Madagascar, Trop. Asia, Australia) – ellipsoid, 324.4 microns long and 172.3 microns wide (Abraham & Subr., 1965).

U. scandens var. *schweinfurthii* Bak ex. Staphf. (Trop. Africa?) – ovoid, smooth with prominent hilium (Taylor, 1954).

U. singeriana F. Muell. (Australia) – shining, four times as long as broad, brown (Erickson, 1968).

U. spiralis Sm. (Trop. Africa) – globose, reticulate cells of testa isodiametric (Taylor, 1954).

Utricularia striatula Sm. (Trop. Africa, India to New Guinea) – glochidiate (Taylor, 1954).

U. stricticaulis Stapf ex. Gamble (India) – obovoid, epidermal cells finely striated and scrobiculate, 329 microns long and 174.2 microns wide (Abraham & Subr., 1965).

U. subulata L. (Nova Scotia to Argentina, Trop. Africa, Madagascar, Siam, Borneo, Portugal) – ovoid, about 0.25 mm long with about 15 longitudinal striations (Taylor, 1975).

U. tenuicaulis Miki = *U. australis* R.Br. (Trop. & S. Africa, Europe, Temp. Asia, Japan, Australia, Tasmania, New Zealand)–angled, truncate at the ends (Ohwi, 1965).

U. uliginosa Vahl. (India to Australia, Japan) –

nearly globular, appearing warty when dry, reticulate only when soaked (Erickson, 1968).

U. unifolia R. & P. (S. and C. America) – narrowly cylindrical, fusiform, 0.35-0.5 mm long (Taylor, 1975).

U. violacea R.Br. (Australia) – minute (Erickson, 1968).

U. yakusimensis Masam = *U. uliginosa* Vahl. – raised oblique striations (Ohwi, 1965).

Discussion and Summary

The seeds of carnivorous plants are quite distinctive generally. The main exceptions are within the species of *Sarracenia* and *Nepenthes*. All the others that I have seen appear to be distinguishable from each other. Hopefully a way will be found to distinguish the various species of *Sarracenia* and *Nepenthes* as well.

One of the major problems with this report is the proper naming of the seeds. I have had no way of checking most of them. I am currently trying to grow all of them. When they germinate it will be possible to tell whether I have the species that I thought I had. Others, like *Utricularia inflexa filiformis*, I never heard of before and I could not find a reference to the plant anywhere. It probably has another name. I will inform everyone if I find any mistakes in the names of the seeds.

I hope that the drawings and key are useful to people in some way. I would be quite happy to correspond with anyone interested in this subject and I would eagerly welcome any extra seed that people might like to donate. I think that some regional keys to species can be constructed soon while a single comprehensive key to all the species will take many years to finish.

Glossary

acute – forming an acute angle at base or apex

alveolae – small cavities as honeycombed

alveolate – honeycombed

apiculate – ending abruptly in a small, usually sharp tip

areolate – marked with areolae or small spaces

attenuate – gradually tapering to a very slender point

bullate – describing a surface with rounded elevations resembling blisters

caudate – having a tail-like terminal appendage

clavate – club-shaped, gradually increasing in diameter toward the summit

crateriform – having the form of a crater

crenulate – diminutive of crenate (with rounded teeth projecting at right angles to the edge)

deltoid – in the shape of an equilateral triangle

dentate – toothed along the margin, the apex of each tooth sharp and directed outward

ellipsoid – shaped more or less like a football or ellipse

elliptic – shaped like an ellipse

endosperm – a nutritive tissue developed in the embryo sac

epidermal cells – outermost layer of cells

filiform – threadlike

funicle – stalk of ovule, attaching it to placenta

fusiform – description of a solid body, thick near the middle and tapering to both ends

globose – spherical or almost spherical

glochidiate – barbed at the tip

hilium – scar or seed coat marking point of former attachment of seed to funicle

hyaline – thin and membranous, being transparent or translucent

isodiametric – having equal diameters

lanceolate – shaped like a lance head, much longer than wide and widest below the middle

lenticular – lens shaped

micropylar endosperm haustorium – ? (I was unable to find a definition for this anywhere)

micropyle – small opening in seed coat through which the pollen tube entered

mucro – a short, sharp, slender point

mucronate – tipped with a short, sharp, slender point

mucronulate – diminutive of mucronate

ob- – a prefix signifying in a reverse direction

oblong – descriptive of a flat organ broader than linear but maintaining its width for a considerable part of its length.

Also describing a solid object which is essentially cylindric or prismatic and therefore appears oblong when viewed from the side.

obtuse – blunt

-oid – blunta

-oid – suffix meaning "like" or similar to

orbicular – round and flat

ovate – descriptive of a flat organ widest below the middle and broader than lanceolate

papillae – projections

papillose – descriptive of a surface beset with short, blunt, rounded or cylindric projections

peltate – shieldlike, supported by a stalk attached near the center of the lower surface, like an umbrella with handle

polygonal – having the form of a plane with several angles

prismatic – of or resembling a prism

pyramidal – having the form of a pyramid (square base and four triangular sides meeting at a point)

pyriform – pear-shaped

reticulate – netted

rhombic – more or less diamond shaped

rhomboidal – having the shape of a three dimensional rhombic figure

rugose – describing a wrinkled surface

scobiform – having form and appearance of sawdust

scrobiculate – having small depressions, pitted

sigmoid – resembling the letter "S"

striate – marked with fine and usually parallel lines

sub- – a prefix meaning more or less or somewhat

tabular – flat

testa – seed coat, hardened integument

truncate – with the base or apex transversely straight or nearly so, as if cut off

tubercle – a minute swollen or tuber-like structure

tuberculate – bearing tubercules

verrucose – warty, covered on a surface with low, rounded protuberances

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Review of Recent Literature

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Steve Williams referred to this older paper to us and wondered if anyone had followed up on the several *Dionaea* plantings made by the author and others earlier (she reviews these to date of publication) in the pine barrens. Her observations at the time indicated considerable seedling activity at some of the locations. She only lists the locations very generally, so someone who knew her would have to do the follow-up. (DES)

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Predacity of the eight species of test fungi was highly correlated to their ability to attract nematodes (r = .98). The presence of traps on the fungi increased attraction ability by a factor as much as 2. (DES)

Joel, D.M. and B.E. Juniper. 1982. Cuticular gaps in carnivorous plant glands. In: The Plant Cuticle, Academic Press, New York, pp. 121-130.
Using *Drosophyllum lusitanicum*, the authors noticed that after neutral red staining, only mature sessile glands of a leaf took the dye while less mature glands mare basal on a developing leaf did not (color photo in paper). E.M. disclosed that as the glands matured, gaps developed in the usually impermeable cuticle so that secretion and absorption could take place in the glands. (DES)

Juniper, B.E. et. al. 1982.The relationships between the dictyosomes and the forms ofendoplasmic reticulum in plant cells with different export programs. Bot. Gaz. 143: 135-145.
In CHO secreting cells of plants, connections between dictyosomes and ER were not observed. In protein secreting CP (enzymes), there are long trains of connections.

Kilham, Peter. 1982. The biogeochemistry of bog ecosystems and the chemical ecology of sphagnum. Mich. Bot. 21: 159-168.
This is a well-written and useful review of work on sphagnum biochemistry and other ecochemistry in bogs. The following systems are discussed critically: cation exchange, atmospheric precipitation (particularly acid rain effects in ombrotrophic bogs), sulfur compound chemistry in the anaerobic depths, organic acids and the hydrologic regime. Each of these is reviewed in itself and in terms of a total ecosystem approach. The author proposes an outline of further research, particularly in terms of total ion and pH budget. The author feels that cation/hydrogen ion exchange in itself has been overly emphasized and may not even be the primary factor in bog chemical equilibrium. Finally, the primary equilibrium system may vary from one bog to another depending on various factors. (DES)

Lamont, B. 1982. Mechanisms for enhancing nutrient uptake in plants, with particular reference to Mediteranean South Africa and Western Australia. Bot. Rev. 598-689.
A portion of this paper (pp. 653-658) covers carnivorous plants and their mechanisms for alternate nutrition in the areas in the title. The main emphasis is on Australian species with a review and collation of several Australian CP physiology studies. (DES)

Meyers, D.G. 1982. Darwin's investigations of carnivorous aquatic plants of the genus *Utricularia*: misconception, contribution and controversy. Proc. Acad. Nat. Sci. of Philadelphia 134: 1-11.
This is a very interesting, well-researched and well-written historical paper reviewing most of Darwin's theories about *Utricularia* as presented in his famous 1875 book, *Insectivorous Plants*. As it turns out, current research has proved Darwin correct in most of his hypotheses and suppositions which in his time were probably beyond testing adequately. Darwin did err in assuming that prey entered the trap by forcing their way in, and the question of digestive enzymes secreted by the plant vs. prey autolysis by bacterial action is still unsolved.

Outenreath, R. and M. Dauwalder. 1982. Ultrastructural and radioautographic studies of the digestive cells of *Drosera capensis*. J. Ultrastruct. Res. 80: 71-88.
Using EM, ultrastructural changes in gland cells are described as they mature. Golgi stacks form large secretory vesicles. (DES)

Schnell, D.E. 1982. Notes on *Drosera linearis* Goldie in northeastern lower Michigan. Castanea 47: 313-328.

This is a general discussion of ecologic and other biological aspects of the species as it occurs in marl fen bogs of the region. Detailed water and soil analyses are presented, along with comments on relationships to other CP in the same areas. It is concluded that the general landward placement of plants in lakeside fens is likely weather related. It is also concluded that the species grows where and how it does largely because of poor competitive ability as indicated by observations in the field and culture experiments. In culture, *D. linearis* appears to have more diverse capability in varying climate and pH environments than previously supposed as long as competition, soil moisture, light and solution total solids are controlled. (Reprints: D.E. Schnell, Rt. 1, Box 145C, Pulaski, VA 24301).

Systsma, K.J. and R.W. Pippen. 1982. The Hampton Creek wetland complex in southwestern Michigan. V. Species of vascular plants. Mich. Bot. 21: 195-204. This fifth paper in a series on the ecology of the wetland in Kalamazoo County is a long species list among which are the following CP: *Drosera rotundifolia, Utricularia intermedia* and *Sarracenia purpurea.* (DES)

THE 1983 LIST OF CP BOOKS

Not available through *CPN*. Order directly from publisher or your local bookshop.
* – books intended primarily for children.

1. Insectivorous plants, Charles Darwin, AMS Press, 1893, 56 E. 13th St., N.Y., NY 10003, $27.50.
2. *Plants that Eat Insects: A Look At Carnivorous Plants, Anabel Dean, Lerner Publications, 1977, 241 First Avenue, Minneapolis, MN 55401. $5.95.
3. Plants of Prey in Australia, Rica Erickson, Univ. of W.A. Press, 1968, World Insectivorous Plants, 1347 17th St., Los Osos, CA 93402, Cloth, $15.00.
4. *Animals & Plants That Trap, Phillip Goldstein, Holiday, 1974, Holiday House, Inc., 18 E. 53rd St., N.Y., NY 10022, $5.95.
5. Nepenthes of Mt. Kinabalu (in English), Kurata, S., Sabah National Park, World Insectivorous Plants, 1347 17th St., Los Osos, CA 93402, $7.00.
6. Carnivorous Plants, Francis E. Lloyd, Peter Smith, 6 Lexington Ave., Magnolia, MA 01930, $10.00.
7. The World of Carnivorous Plants, J. and P. Pietropaolo, R.J. Stoneridge, Peter Paul Nurseries, 1974, $6.30.
8. *Insect-Eating Plants, L. and G. Poole, T.Y. Crowell, 1963, 666 Fifth Avenue, N.Y., NY 10003, $4.50.
9. *Plants That Eat Animals, J.H. Prince, Thomas Nelson, 1978, 407 Ave. S., Nashville, TN 37203, $7.95.
10. CP of the U.S. and Canada, D.E. Schnell, John F. Blair, Publisher, 1976, 1406 Plaza Dr., SW, Winston-Salem, NC 27103, $19.95 plus shipping.
11. Carnivorous Plants, Randall Schwartz, Avon Books, 1975, 959 Eighth Ave., N.Y., NY 10019, soft cover $1.25.
12. Carnivorous Plants, Adrian Slack, MIT Press, 1979, 28 Carleton St., Cambridge, MA 02142, $19.95.
13. Cultivating Carnivorous Plants, Allen Swenson, Doubleday & Co., 1977, Garden City, NY 11535, $7.95.
14. *Carnivorous Plants, John F. Waters, Franklin Watts, Inc., 1974, 845 Third Avenue, N.Y., NY 10022, $4.90.
15. *Carnivorous Plants, Cynthia Overbeck, Lerner Publications, 1981, 241 First Avenue, Minneapolis, MN 55401, $8.95.
16. *Secrets of the Venus's Fly Trap, Jerome Wexler, Dodd, Mead & Co., 1981, 79 Madison Ave., N.Y., NY 10016, $6.95.

1983 CP SOURCES

Note: All individuals or organizations selling, trading or buying CP are advised to be cognizant of certain restrictions under the U.S. ESA and international CITES for certain species (see editorial).

Name and Address	Catalog Price	Stock
Carnivorous Gardens P.O. Box 224 Stones Corner 4120 Brisbane, Queensland Australia	$.75	*Native seed*
Carolina Exotic Plants P.O. Box 1492 Greenville, NC 27834	$.75	*Dionaea, Drosera, Sarracenia, Darlingtonia, Pinguicula, Utricularia, live Sphagnum*
Chatham Botanical P.O. Box 691 Carrboro, NC 27510 Telephone (919) 929-2003	$.50	*Pinguicula, Drosera, Dionaea, Cephalotus – tissue culture, other tissue cultured CP – inquire*
Country Hills Greenhouse Rt. 2 Corning, OH 43730	$2.00 refundable with order	*Nepenthes (20 varieties)*
Exoticana Seeds P.O. Box 184 Greytown 3500, South Africa		*Native CP seed*
Hinode-Kadan Nursery 2735 Nakanogo, Hacijyot Hachijyo-Island Tokyo 100-16 Japan	International Reply Coupon	*Byblis, Cephalotus, Drosera, Pinguicula, Nepenthes, Utricularia*
Lee's Botanical Garden P.O. Box 7026 Ocala, Fl 32672	Free	*Sarracenia, Utricularia, Pinguicula, Nepenthes, Drosera, Dionaea*
Marston Exotics Spring Gardens Frome Somerset, England	50 p	*Serving Britain & Europe only*
Milingimbi Nursery World of CP P.O. Box 5 Seaforth, NSW, Australia 2092	Free	*Byblis, Cephalotus, Drosera, Dionaea, Nepenthes, Utricularia, Sarracenia, Pinguicula*
Orgel's Orchids Rt. 2, Box 90 Miami, FL 33187	Free	*Byblis, Dionaea, Drosera, Nepenthes, Pinguicula, Sarracnia*
Peter Pauls Nurseries Canadaigua, NY 14424	$.50	*Sarracenia, Dionaea, Drosera, Utricularia, Darlingtonia, Nepenthes seed, Pinguicula, live Sphagnum*
Plant Shop's Botanical Garden 18007 Topham St. Reseda, CA 91335	$2.00 refundable with order	*Drosera, Byblis liniflora, Pinguicula, Sarracenia, Nepenthes, Cephalotus, Dionaea, Utricularia*

Renate Parsley 8 Langton Rd. Mowbray 7700 South Africa		*Native CP seed*
W.T. Neale & Co., Ltd., B.M. & S. Lamb 16/18 Franklin Rd. Worthing, Sussex, BN132PQ England	inquire	*Sarracenia, Dionaea, Darlingtonia seed*
World Insectivorous Plants 1347 17th St. Los Osos, CA 93402	$.50	*Cephalotus, Dionaea, Drosera, Drosophyllum, Nepenthes, Sarracenia, Pinguicula, Byblis liniflora, Utricularia*

Nurseries in Great Britain (sent in by Christopher Hynes):

Heldon Nurseries
Asbourne Rd.
Spath
Uttoxeter ST145AD

Cyril G. Brown
65 Highfield Cres.
Hornchurch
Esex RM126PX

Sarracenia Nurseries
Links Side
Courtland Ave.
Mill Hill, London NW7

South West Seeds
Doug & Vivi Rowland
200 Spring Rd.
Kempston, Bedford MK428ND

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When submitting Want Ads, please be sure to print clearly for best results and to eliminate mistakes. Please circle the correct letter before each item (Want, Trade, Sell or Buy). Want ads are limited to carnivorous plants, terrariums, greenhouses and moss. There is a charge of ten cents per item, with no limit to the number of items you may submit per issue.

Send coin or check to:
Arboretum, Want Ads
California State University
Fullerton, CA 92634

Greg Davis (23 Winged Foot Ct., San Ramon, CA 94583) (WB) any *Nepenthes,* any *Sarracenia* (except *S. purpurea purpurea*, any *Pinguicula* (except *P. caerulea*), any *Drosera* (except *D. montana*), any Byblis, (WBT) any Heliamphora.

Cliff Dodd II (c/o the Aku Tiki Inn, 2225 S. Atlantic Ave., Daytona Beach, FL 32018) (TS) *D. capensis, Nepenthes gracilis, N. rafflesiana* (Borneo), *N. burkei, N. alata* (gr.) *N. trichocarpa, others,* (WT) N. *species* plants/cuttings (TS) starts or plants of various Drosera and Utrics.

Lee's Botanical Gardens (P.O. Box 7026, Ocala, FL 32672) (TS): *Nepenthes maxima, gracillima, ampullaria, anamensis,* × *williamsi,* × *emmarene,* × *dormanniana,* × *intermedia,* × *dyeriana,* × *fukakusana,* × *mixta;* (WTB): *stenophylla,* fusca-green, albo-marginata red, × St. Louis, × mizuho, × toyoshimae, × nobilis, × nagoya, × arakawae.

Helmut Kibellis (99 Cecil Ave., Castle Hill 2154, NSW, Australia) (WTB) Pinguiculas (cold climate & Mexican) seeds or plants; (WT) many Sarracenia hybrids, *D. indica, D. adelae, N. facia, N.* "Kosobe," *Byblis liniflora, P. caerulea, P. lusitanica, P. lutea* and other CP; ask for list.

Jerry Phelps (6013 Innes Trace Rd., Louisville, KY 40222) (S) *D. adelae, D. capensis;* (WB) any Heliamphora except heterodoxa.

Steve Smith (1159 Trim St., Kirkwood, NY 13795) (W) *Nepenthes rajah* and *N. edwardsiana*; have Heliamphora to exchange for above or many other species; (TS) Nepenthes cuttings, Mexican Pinguicula, Drosera and others. Send SASE for current list of available species.

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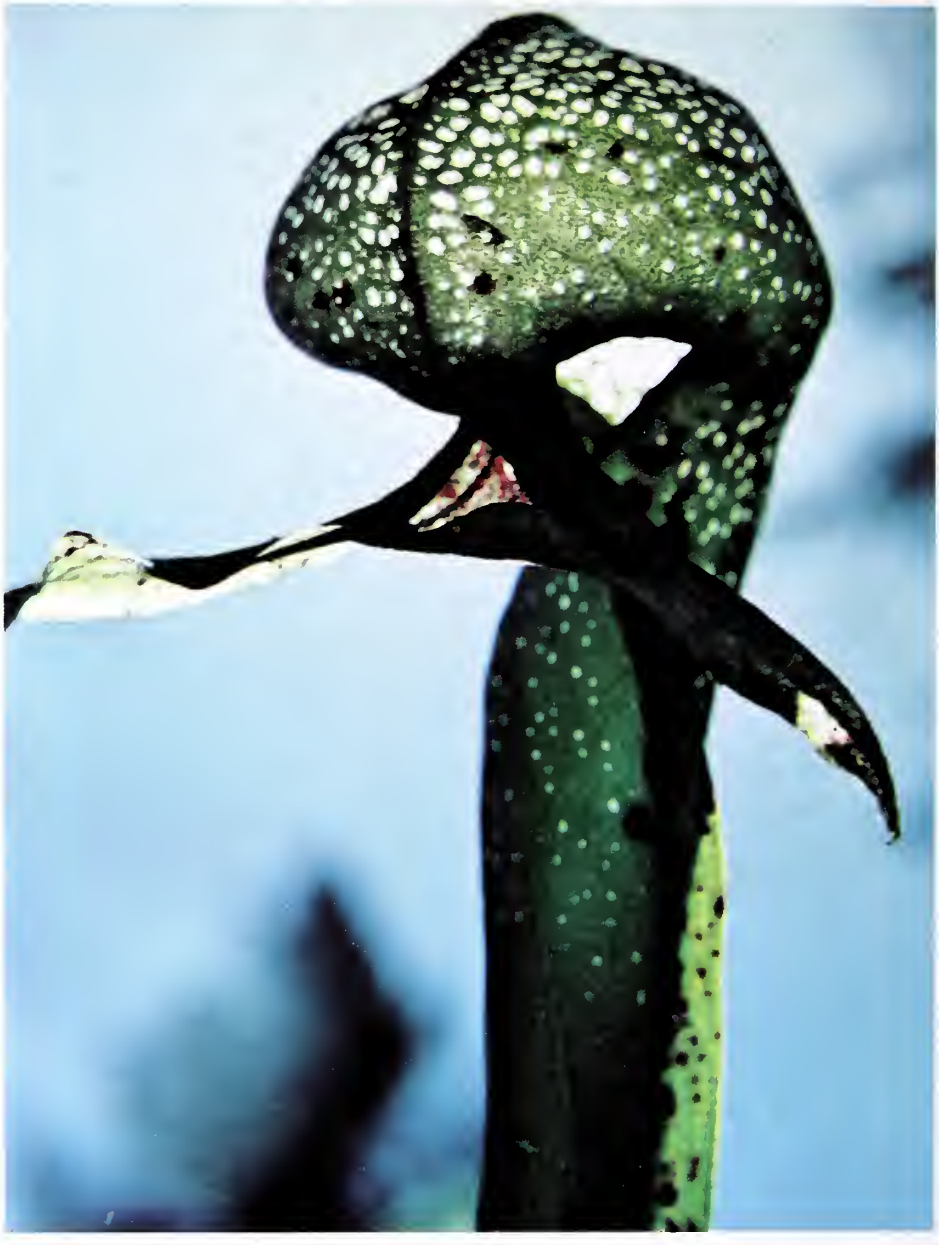

Darlingtonia californica

Notice the abundant windows and cobra-like aspect, hence the common name "cobra lilly."

Photo by J.A. Mazrimas.